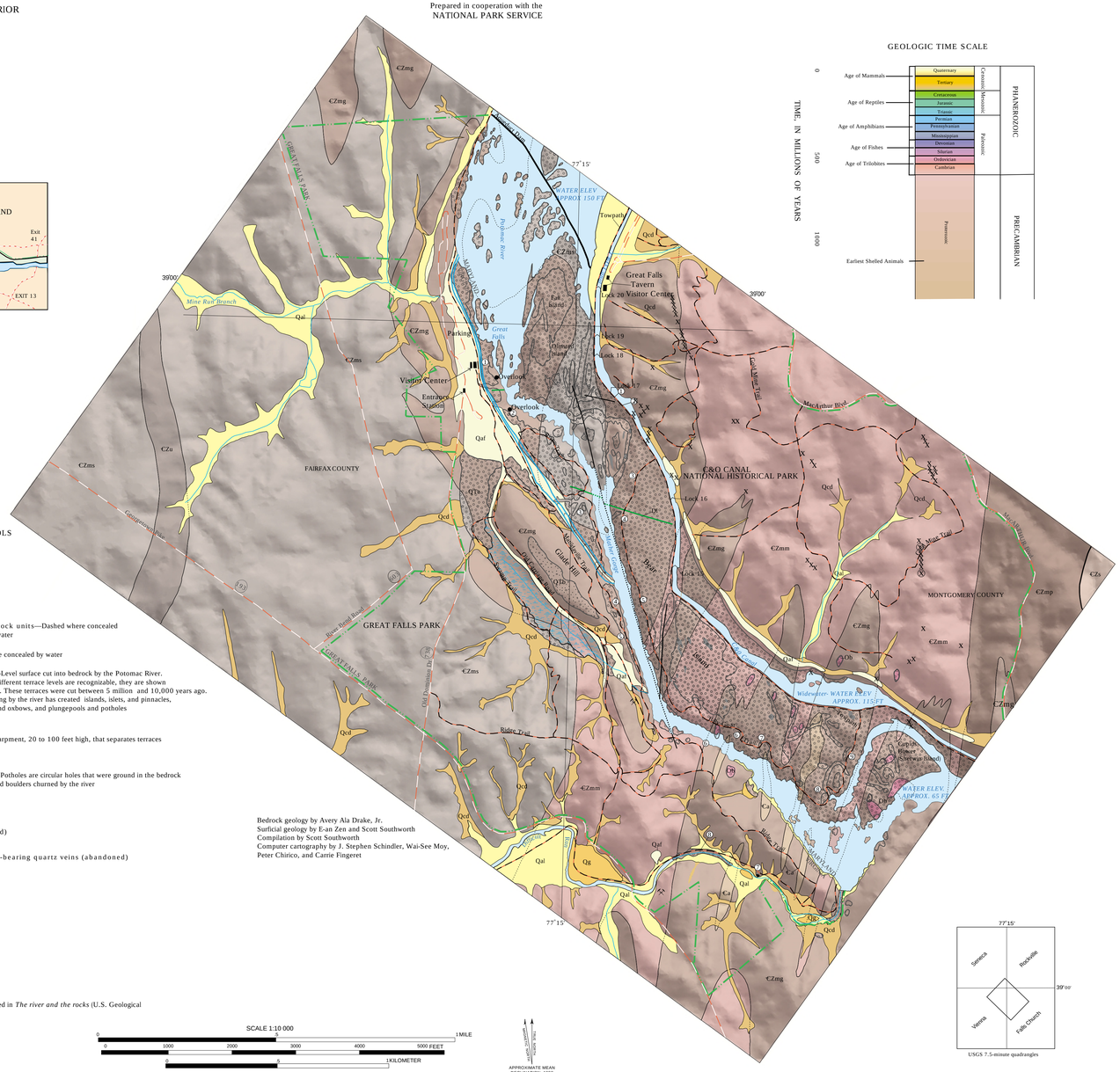
OPEN - FILE REPORT 00-264

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
NATIONAL PARK SERVICE



GEOLOGIC TIME SCALE

EXPLANATION OF MAP SYMBOLS

- Park boundary
- Road
- Trail
- Contact between rock units—Dashed where concealed by other units or by water
- Fault—Dashed where concealed by water
- Terrace deposits—Level surface cut into bedrock by the Potomac River. Although at least six different terrace levels are recognizable, they are shown combined on the map. These terraces were cut between 5 million and 10,000 years ago. Subsequent downcutting by the river has created islands, islets, and pinnacles, shoestring channels and oxbows, and plungepools and potholes
- Terrace berm—Escarpment, 20 to 100 feet high, that separates terraces
- Area of potholes—Potholes are circular holes that were ground in the bedrock riverbed by pebbles and boulders churned by the river
- Quarry (abandoned)
- Prospects for gold-bearing quartz veins (abandoned)
- Pit
- Shaft or adit
- Patowmack Canal
- Canal lock
- Swamp
- Trail Stop—Discussed in *The river and the rocks* (U.S. Geological Survey Bulletin 1471)

Bedrock geology by Avery Ala Drake, Jr.
Surficial geology by E-an Zen and Scott Southworth
Compilation by Scott Southworth
Computer cartography by J. Stephen Schindler, Wai-See Moy, Peter Chirico, and Carrie Fingeret

SCALE 1:10 000
0 .5 1 MILE
0 1000 2000 3000 4000 5000 FEET
0 .5 1KILOMETER

APPROXIMATE MEAN DECLINATION, 1999

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

- Qaf — Artificial fill and ground disturbed by construction
- Qal — Alluvium (Holocene—present to 10,000 years old)—Unconsolidated clay, silt, sand, gravel, and cobbles in valley bottoms
- Qg — Alluvial gravel-bar deposits along Difficult Run (Holocene and late Pleistocene—present to 100,000 years old)
- Qcd — Colluvium (Holocene and late Pleistocene—present to 100,000 years old)—Cobbles, boulders, and debris in slope hollows
- QTa — Unconsolidated clay, silt, sand, and gravel deposited on level surfaces called terraces (Holocene and Pliocene—10,000 to 5 million years old)
- QTb — Boulder deposit on crest of Glade Hill; is remnant of highest and oldest terrace (Holocene and Pliocene—10,000 to 5 million years old)

OLDER IGNEOUS ROCKS

- Dl — Lamprophyre dikes (Late Devonian-about 360 million years old)—Dark-colored, biotite mica-rich tabular intrusions that cut across the surrounding rock
- Ob — Bear Island Granodiorite and pegmatite bodies (Ordovician-about 470 million years old)—Light-colored, muscovite mica-rich, elliptical intrusive bodies and small tabular intrusions
- €a — Amphibolite sills (Early Cambrian-about 540 million years old)—Dark-colored, hornblende-rich tabular intrusions, emplaced parallel to the bedding of the surrounding rock

METAMORPHOSED SEDIMENTARY ROCKS (Lower Cambrian and (or) Late Proterozoic—about 600 million years old)

Sykesville Formation

- €Zs — Melange—Gray, fine-grained mixture of quartz and feldspar, with pebbles of white quartz and blocks of greenish-gray phyllonite; originally deposited on the ocean floor

Mather Gorge Formation

- €Zms — Quartz-rich schist and mica gneiss—Greenish-gray rocks with different textures; schist is finer grained, more planar, and less massive than gneiss
- €Zmg — Metagraywacke and metasiltstone schist—Well-bedded, gray, dirty sandstone interbedded with siltstone; originally deposited in submarine turbidity currents on the ocean floor
- €Zmm — Migmatite—Complex, light- and dark-gray rock formed when rocks of different ages were melted together
- €Zmp — Phyllonite with vein quartzs—Shiny, greenish-gray, fine-grained sheared rock with pods and veins of white quartz

OLDER IGNEOUS ROCKS

- €Zu — Ultramafic rocks—Dark-green igneous rocks consisting of serpentinite, soapstone, and talc schist; occur as sedimentary blocks and fragments in the Mather Gorge Formation

INTRODUCTION

This geologic map shows the types of rock and landforms of the Potomac River Gorge within the Piedmont physiographic province of the Central Appalachian region. The map was produced from information collected by geologists over a period of more than 25 years (Reed and Reed, 1969; Drake and Lee, 1989; Drake and Froelich, 1997; and Drake and others, 1999). The data were computerized to make a geographic information system (GIS) for the National Park Service and to provide a color map for park visitors. Readers are referred to *The River and the Rocks* (U.S. Geological Survey Bulletin 1471, by Reed and others, 1980) because it more fully describes the geology of the area.

BEDROCK GEOLOGY

Most of the metamorphosed sedimentary rocks of the area are named the Mather Gorge Formation, after the rocks exposed there. They lack fossils but are interpreted to be about 600 millions years old. These rocks were originally deposited as sand, silt, and mud in an ancient sea, called the Iapetus Ocean, which existed before the Atlantic Ocean. Large blocks and fragments eroded from an older igneous rock (map unit €Zu) were mixed with the sediments. Igneous rocks—hot, molten rocks deep below the Earth's surface—were injected up into the sedimentary rocks at various times in the geologic past. These igneous rocks, and their times of emplacement, include amphibolite (about 540 million years ago), granodiorite and pegmatite (about 470 million years ago), and lamprophyre (about 360 million years ago).

The sedimentary rocks were changed by heat and pressure (metamorphosed) and deformed during several collisions of the Earth's continental plates that resulted in the formation of the Appalachian Mountains. Metamorphism changed the sedimentary and igneous rocks into schist and gneiss (map unit €Zms), and migmatite (map unit €Zmm). Hot solutions of silica were injected as veins of white quartz into the rocks, and crystals of muscovite (white mica), biotite (black mica), garnet, staurolite, and kyanite grew as the rocks cooled. Some of the vein quartz nearby in Maryland was extensively prospected and mined for gold from 1861 to 1951; note the abandoned prospect sites on the map. The metamorphosed rocks are tightly folded, they are well layered with mica-rich foliation planes, and locally they contain close-spaced fractures.

LANDSCAPE EVOLUTION

The landscape of the area is mostly the result of erosion by the Potomac River during the past 5 million years. As the Potomac River flows to the southeast, it cuts obliquely across several types of north-trending bedrock units. The river follows the trend of joints (cracks) and faults along the straight river course in Mather Gorge.

Level surfaces called terraces, which have been cut into bedrock at different elevations by the Potomac River, form conspicuous features of the landscape. The terraces are actually remnants of old flood plains of the downcutting Potomac. There are at least six recognizable terrace levels, but they are all shown combined in order to be more readable at the map scale. The highest and oldest terrace is on the crest of Glade Hill in Great Falls Park, where a deposit of river boulders of quartzite and diabase is found (unit QTb). The Great Falls Park entrance, parking lots, picnic area, visitor center, and Patowmack Canal are on the second highest and next oldest terrace. When the Potomac River was downcutting through this terrace into the bedrock, Glade Hill was an island. There are at least four younger terrace levels within the gorge. Downcutting by the Potomac River into these terraces has created islands, islets, pinnacles, shoestring channels, oxbows, plungepools, and potholes. The erosional features are best seen on Bear Island. The C&O Canal utilizes an abandoned channel of the Potomac River at Widewater that in part creates Bear Island. Alluvial stream deposits are best preserved along parts of Difficult Run, whereas most alluvial deposits along the Potomac River have been removed during floods. The bedrock terraces provide excellent exposures of Piedmont bedrock and the fascinating landforms eroded into them.

REFERENCES CITED

Drake, A.A., Jr., and Lee, K.Y., 1989, Geologic map of the Vienna quadrangle, Fairfax County, Virginia, and Montgomery County, Maryland: U.S. Geological Survey Geologic Quadrangle Map GQ–1670, scale 1:24,000.

Drake, A.A., Jr., and Froelich, A.J., 1997, Geologic map of the Falls Church quadrangle, Fairfax and Arlington Counties and the City of Falls Church, Virginia, and Montgomery County, Maryland: U.S. Geological Survey Geologic Quadrangle Map GQ–1734, scale 1:24,000.

Drake, A.A., Jr., Southworth, Scott, and Lee, K.Y., 1999, Geologic map of the Seneca quadrangle, Montgomery County, Maryland, Fairfax and Loudoun Counties, Virginia: U.S. Geological Survey Geologic Quadrangle Map GQ–1802, scale 1:24,000.

Reed, J.C., Jr., and Reed, J.C., 1969, Gold veins near Great Falls, Maryland: U.S. Geological Survey Bulletin 1286, 22 p.

Reed, J.C., Jr., Sigafoos, R.S., and Fisher, G.W., 1980, The river and the rocks—The geologic story of Great Falls and the Potomac River Gorge: U.S. Geological Survey Bulletin 1471, 75 p.

GEOLOGIC MAP OF THE POTOMAC RIVER GORGE:
GREAT FALLS PARK, VIRGINIA, AND PART OF THE C&O CANAL NATIONAL HISTORICAL PARK, MARYLAND

Compiled by Scott Southworth and Carrie Fingeret
2000

Base Map from U.S. Geological Survey 7.5-minute 1:24,000-scale quadrangles:
Falls Church, Rockville, Seneca, and Vienna
Islands and shorelines were revised using aerial photographs taken in 1995
Polyconic projection. 1927 North American Datum